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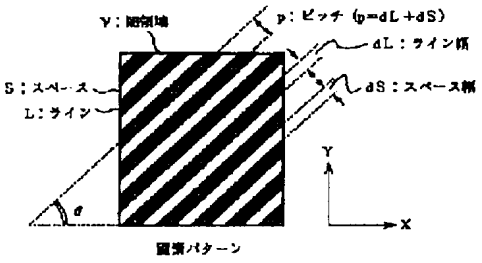
(54) DIFFRACTION GRATING RECORDING MEDIUM AND PREPARING METHOD FOR THE SAME

(57) Abstract:

PURPOSE: To provide the diffraction grating recording medium and preparing method for the same with which luminance and picture quality are not lowered even when plural motifs are expressed while being overlapped.

CONSTITUTION: A diffraction grating image overlapping a motif A expressing an English character 'A' and a motif B expressing an English character 'B' is formed. The motifs A and B expressed by the picture element arrangement of 7x7 are prepared, a diffraction grating pattern at the grating line arranging angle of 90° is allocated to picture elements consisting of only the motif A, and a diffraction grating pattern at the grating line arranging angle of 45° is allocated to picture elements consisting of only the motif B. Besides, a multiple diffraction grating pattern recording grating lines at 90° and 45° while overlapping them is allocated to picture elements consisting of both the motifs A and B. The relation between line width dL of the grating line and space width dS is set so as not to be more than dL:dS=1:2. In order to plot the multiple diffraction grating pattern, a negative pattern is used and a quadrangular space part is plotted.



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* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to a diffraction grating recording medium suitable for use on the diffraction grating seal for security for proving that they are a diffraction grating recording medium and a preparation method for the same, especially a genuine article, and a preparation method for the same.
[0002]
[Description of the Prior Art]The hologram seal is used as a means for preventing forgery of a credit card, a passbook, a gold note, etc. In order to prevent a pirate edition from appearing on the market also about goods, such as videotape and a high-class wrist watch, the hologram seal is used, in addition the hologram seal is used also for the purposes, such as an object for an ornament, and an object for sales promotion. Not a three-dimensional stereoscopic model but a two-dimensional pattern is used for such a hologram seal as a motif in many cases.
[0003]The optical hologram photographing method in which an interference fringe is made to form using a laser beam as a method of creating a hologram seal is common. That is, prepare the manuscript in which the two-dimensional pattern motif was drawn, irradiate this manuscript with one side of the laser beam which branched two, that catoptric light and branched another laser beam are made to interfere, and that interference fringe is recorded on sensitization material. In this way, if a hologram original plate is created, a hologram seal can be mass-produced with the technique of a press using this original edition.
[0004]However, these days, since the image processing technique by a computer and the drawing art by an electron beam progressed, an electron beam is scanned based on the image data prepared by computer, and the method of creating a false hologram original plate is put in practical use. That is, a detailed diffraction grating is recorded on a medium and this diffraction grating expresses the motif of a two-dimensional pattern. For example, the new method of forming a diffraction grating recording medium is proposed by the Japanese-Patent-Application-No. No. 148681 [five to] specification by expressing a two-dimensional pattern by two or more pixels, and assigning the pixel pattern which allots many diffraction gratings to each pixel. The efficient preparation method for mass-producing such a diffraction grating recording medium is indicated by the Japanese-Patent-Application-No. No. 317273 [five to] specification.
The improvement point for expressing the pattern which had gradation in the Japanese-Patent-Application-No. No. 317274 [five to] specification is indicated, and the improvement point for expressing the pattern which had color in the Japanese-Patent-Application-No. No. 177505 [six to] specification is indicated.

[0005]
[Problem(s) to be Solved by the Invention]In the diffraction grating recording medium mentioned above, on the same flat surface, when expressing several different motifs, the arrangement angle of a grid line will use several mutually different pixel patterns for every motif. For example, to the pixel which assigns the pixel pattern whose grid line arrangement angle is 45 degrees to the pixel which constitutes the motif A, and constitutes the motif B. If the pixel pattern whose grid line arrangement angle is 90 degrees is assigned, when the motif A is observed when it observes from a predetermined angle, and it observes from another angle, it will become possible to create a diffraction grating recording medium with which the motif B is observed.
[0006]However, when the motif A and the motif B lap on a flat surface, a certain device is needed. Then, conventionally one pixel was divided into two or more sub-picture elements, and how to assign a pixel pattern for every sub-picture element is taken. For example, if one pixel is divided into four sub-picture elements which

consist of two rows of two lines, the pixel pattern for the motif A is assigned to the sub-picture element of the upper left and the lower right and the pixel pattern for the motif B is assigned to the sub-picture element of the lower left and the upper right, Even if the motif A and the motif B may overlap in a pixel unit, do not overlap per sub-picture element and to each sub-picture element. Only either one of the pixel pattern whose grid line arrangement angle is 45 degrees or pixel pattern whose grid line arrangement angle is 90 degrees will be assigned, and it stops producing trouble.

[0007]However, one pixel is divided into two or more sub-picture elements in this way, a pixel pattern is assigned, and the problem that luminosity and image quality deteriorate at the time of observation is among the diffraction grating recording media which took the method of carrying out the duplicate record of two or more motifs. For example, when it divides into four sub-picture elements as mentioned above, at the time of observation, the diffracted light is not obtained from the one whole pixel, but when the motif A is observed, only the diffracted light from the sub-picture element of the upper left and the lower right is obtained, but when the motif B is observed, only the diffracted light from the sub-picture element of the lower left and the upper right is obtained. For this reason, compared with the case where each motif is recorded independently, respectively, luminosity becomes half and only a picture dark on the whole is acquired. In order to use a sub-picture element instead of a pixel, image quality will also deteriorate.

[0008]Then, an object of this invention is to provide a diffraction grating recording medium with which luminosity and image quality do not deteriorate, and a preparation method for the same, even if it expresses two or more motifs in piles.

[0009]

[Means for Solving the Problem]

(1) In a diffraction grating recording medium which expressed a predetermined motif by a diffraction grating, the 1st mode of this invention records both sides of the 1st grid line that turned to the 1st direction, and the 2nd grid line that turned to the 2nd direction in the same closed region.

[0010](2) In a diffraction grating recording medium concerning the 1st above-mentioned mode, a grid line that a relation dS>=2 and dL come [a relation] between the linewidth dL and the space width dS is obtained is used for the 2nd mode of this invention.

[0011](3) In a diffraction grating recording medium concerning the 2nd above-mentioned mode, constitute the 3rd mode of this invention so that a line part of a grid line may make heights and a space portion may make a crevice.

[0012](4) In a diffraction grating recording medium concerning the 3rd above-mentioned mode, a grid line with the space width dS with which it is satisfied of a formula as for which dS>lambda becomes is used for the 4th mode of this invention to the predetermined visible wavelength lambda.

[0013](5) In a diffraction grating recording medium which the 5th mode of this invention requires for the 4th above-mentioned mode, The predetermined observing angle theta is defined to a normal stood to a recording medium surface, and a grid line with the linewidth dL and the space width dS with which it is satisfied of a formula as for which -(dS+dL) sin theta=lambda becomes is used.

[0014](6) In a diffraction grating recording medium as which the 6th mode of this invention expressed two or more motifs by a diffraction grating, The 1st pixel pattern that arranges many 1st grid line that turned to the 1st direction in a pixel closed region, The 2nd pixel pattern that arranges many 2nd grid line that turned to the 2nd direction in a pixel closed region, A multiplex pixel pattern which stations many both sides of the 1st grid line and the 2nd grid line in a pixel closed region, Give a definition and the 1st pixel pattern is assigned to a pixel which constitutes only the 1st motif, The 2nd pixel pattern is assigned to a pixel which constitutes only the 2nd motif, and a multiplex pixel pattern is assigned to a pixel which constitutes both sides of the 1st motif and the 2nd motif.

[0015](7) In a diffraction grating recording medium as which the 7th mode of this invention expressed two or more motifs by a diffraction grating, A pixel pattern which arranges many grid lines in a predetermined pixel closed region, By changing an arrangement angle of a grid line, define more than one and a pixel pattern of these plurality, It divides into two or more groups by making into one group a pixel pattern which an arrangement angle of a grid line approximates mutually, One group is matched about each of two or more motifs which should be expressed, A multiplex pixel pattern obtained by arranging in piles a grid line arranged at each in the same pixel closed region about two pixel patterns which belong to a different group is defined, To a pixel which assigns a pixel pattern which belongs to a group matched with the motif to a pixel which constitutes only a single motif, and constitutes two motifs. A multiplex pixel pattern in which a pixel pattern which belongs, respectively was

defined as two groups matched with each motif is assigned.
[0016](8) In a diffraction grating recording medium as which the 8th mode of this invention expressed two or more motifs by a diffraction grating, A pixel pattern which arranges many grid lines in a predetermined pixel closed region, By changing an arrangement angle of a grid line, define more than one and a pixel pattern of these plurality, It divides into two or more groups by making into one group a pixel pattern which an arrangement angle of a grid line approximates mutually, One group is matched about each of two or more motifs which should be expressed, A multiplex pixel pattern obtained by arranging in piles a grid line arranged at each in the same pixel closed region about two pixel patterns which belong to a different group is defined, About a pixel which constitutes only a single motif. About a pixel which assigns a pixel pattern which belongs to a group matched with the motif to each sub-picture element produced by dividing this, and constitutes two or more motifs. A pixel pattern which belongs to each of a group which was matched with each motif, or its multiplex pixel pattern is assigned to each sub-picture element produced by dividing this, It constitutes so that a grid line arranged with a grid line arrangement angle relevant to each group may appear in at least one sub-picture element.
[0017](9) In a way the 9th mode of this invention creates a diffraction grating recording medium which expressed a predetermined motif by a diffraction grating, A stage which prepares the 1st pattern that arranges many 1st grid line that turned to the 1st direction as 1st topographic contour plot form data that expressed a border line of a space area between grid lines with a quadrangle, A stage which prepares the 2nd pattern that arranges many 2nd grid line that turned to the 2nd direction as 2nd topographic contour plot form data that expressed a border line of a space area between grid lines with a quadrangle, It asks for a multiplexed pattern on which the 1st pattern and 2nd pattern were put by a logical operation about the 1st topographic contour plot form data and the 2nd topographic contour plot form data, A stage prepared as 3rd topographic contour plot form data that expressed a crossing area of a quadrangle which constitutes the 1st topographic contour plot form data for this multiplexed pattern, and a quadrangle which constitutes the 2nd topographic contour plot form data with a new quadrangle, A stage of performing beam irradiation only to a square type region which scanned a beam with a stage which forms a regist layer, and character to change a state of a regist layer, based on the 3rd topographic contour plot form data in which a multiplexed pattern is shown, and was defined with this data on an original edition composition layer, A stage of performing development which leaves only a beam irradiation field of the regist layers, An exposed region which is not covered with a residual regist layer among original edition composition layers is etched with an etching method, and it is made to perform a stage where a square type region creates the original edition which makes convex, and a stage where a square type region creates a diffraction grating recording medium which makes a concave using the original edition.
[0018](10) In a way the 10th mode of this invention creates a diffraction grating recording medium which expressed two or more motifs by a diffraction grating, A stage which prepares two or more pixel patterns which arrange many grid lines in a predetermined pixel closed region by changing an arrangement angle of a grid line, A stage which prepares motif pixel information which expressed a predetermined motif by defining two or more pixels which had a predetermined pixel value, respectively as a prescribed position on a flat surface about each of two or more motifs, Based on each pixel value in motif pixel information, about a stage which matches a predetermined pixel pattern with each picture element position, and a picture element position where a single pixel pattern was matched. About a picture element position which assigned this single pixel pattern and where two different pixel patterns were matched, it is made to perform a stage of assigning a multiplex pixel pattern on which these two matched pixel patterns were put.
[0019]
[work --] for A fundamental concept of this invention is at a point which carries out multiplex recording of two or more motifs using a multiplex diffraction grating which recorded two kinds of grid lines with which direction differs in the same closed region. A diffraction grating comes to form many slots which had three-dimensional rugged structure on the surface of a medium, and each slot, i.e., grid lines, was a preconceived idea of the former [form / in the single direction / in parallel]. An invention-in-this-application person found out that it was possible to make diffraction phenomena start about each grid line, also when two kinds of grid lines with which direction differs were recorded in piles.
[0020]However, by such a multiplex diffraction grating, in order to make usable diffraction phenomena start, specific conditioning is needed. When using a grid line that a relation dS>=2 and dL come [a relation] between the linewidth dL and the space width dS was obtained according to the experiment which an invention-in-this-application person conducted, it has checked that a medium which functions as a multiplex diffraction grating was obtained. And if it constitutes so that a line part of a grid line may make heights and a space portion may

make a crevice on a medium, a practically more bright multiplex diffraction grating will be obtained. In the case of a multiplex diffraction grating which makes human being an observer, the space width dS to which a formula as for which dS>lambda becomes is satisfied is needed to the predetermined visible wavelength lambda. This shows conditions that the space width dS which constitutes a crevice is larger than the visible wavelength lambda, and serves as conditions required in order to introduce light of the visible wavelength lambda into a crevice. When using a diffraction grating recording medium as a seal for forgery prevention, it is common that a specific observing angle becomes settled. For example, if it uses as a seal for forgery prevention for a credit card, it is common to determine an angle which inclined to the front about 30 degrees to a normal stood on the surface of a credit card as a temporary observing angle. An invention-in-this-application person defines the observing angle theta predetermined [according to a use], and receives the predetermined visible wavelength lambda, (dS+dL) When a grid line with the linewidth dL and the space width dS with which it is satisfied of a formula as for which -sin theta=lambda becomes was used, it checked that the optimal diffraction grating recording medium for the use could be formed. (dS+dL) A becoming formula of -sin theta=lambda is a formula obtained by considering it as the order of diffraction n= 1 in Bragg's equation in case a pitch of a diffraction grating is (dS+dL), and it becomes conditions required in order to obtain the brightest primary diffracted light in a predetermined observing angle.

[0021]If such a multiplex diffraction grating is used, also when expressing two or more motifs which overlap mutually on the same flat surface, it becomes unnecessary to use a sub-picture element like before. For example, a pixel pattern whose grid line arrangement angle is 45 degrees expresses the motif A, What is necessary is to assign a 45-degree pixel pattern to a pixel which constitutes the motif A, and just to assign a 90-degree pixel pattern to a pixel which constitutes the motif B, when a pixel pattern whose grid line arrangement angle is 90 degrees expresses the motif B. And what is necessary is just to assign a multiplex pixel pattern which recorded in piles a grid line arranged at 45-degree direction, and a grid line arranged at 90-degree direction to a pixel which constitutes both sides of the motifs A and B. Since it becomes unnecessary to divide one pixel into a sub-picture element, it stops producing a problem that luminosity and image quality deteriorate like before.

[0022]A multiplex pixel pattern can be easily generated by the operation which used a computer. Efficient work can be done, if it draws a square type region which had the neighborhood surrounded by grid line in drawing a multiplex pixel pattern with an electron beam.

[0023]

[Example]Hereafter, it explains based on some examples illustrating this invention.

[0024]**1. Explain briefly the composition of the conventional diffraction grating recording medium indicated by the Japanese-Patent-Application-No. No. 148681 [five to] specification etc. which were mentioned above at the beginning of the conventional diffraction grating recording medium. First, drawing 1 (a) The conventional method of expressing a motif ("A" of an English character is shown) as shown on a diffraction grating recording medium is explained. First, it is drawing 1 (a). As image data corresponding to the shown motif, it is drawing 1 (b). Motif pixel information as shown is prepared. In the example shown here, the pixel is arranged by seven rows of seven lines, each pixel has a pixel value of either "0" or "1", and it becomes the information which shows what is called a binary picture. Such information is general image data currently called what is called "raster image data."

the usual illustrating -- it can create with a device.

Or such motif pixel information may be prepared by incorporating the design drawing drawn on space with a scanner device.

[0025]Then, as shown in drawing 2, the pixel pattern which arranges the line L with the linewidth dL and the space S with the space width dS by turns in the closed region V is defined. The line L is a portion used as a grid line on a medium.

The grid line of the width dL will separate only the interval dS mutually, and will be formed. [many]

The pitch p of such a diffraction grating serves as p=dL+dS, and the line L (grid line) is arranged by each with the same angle theta. Here, the closed region V is a field which constitutes one pixel, and becomes a actual very minute element. If another word is carried out, it will be drawing 1 (a). (b) The considerable bottom becomes a thing of a size to each pixel in the arrangement of 7xshown 7. Although vertical x width uses the rectangle of the size which are 50 micrometers x 45 micrometers as the closed region V in this example, the thing of a square with a size of 50 micrometers x 50 micrometers may be used, for example. The width dL of the line L and the width dS of the space S which are arranged in this closed region V also have a minute size according to the

wavelength of light, and are p= 1.2 micrometers in linewidth dL=0.6micrometer, space width dS=0.6micrometer, and pitch in this example.

[0026]In short, the line L needs to be arranged in the linewidth dL and the pitch p which achieve the function as a diffraction grating. The arrangement angle theta of the line L is an angle set up to the predetermined reference axis. This specification will define the XY coordinate system which took the X-axis and a Y-axis in the direction which is illustrated, and the arrangement angle theta of the line L will be expressed with it by using the X-axis as a reference axis. Of course, such a pixel pattern will be prepared as image data in a computer. Next, drawing 1 (b) Based on each pixel value in motif pixel information as shown, a pixel pattern as shown in drawing 2 is matched with a predetermined pixel, and processing which arranges the pixel pattern corresponding to each picture element position is performed. Specifically, it is drawing 1 (b). In the shown motif pixel information, a pixel value matches the pixel pattern of drawing 2 with each of the pixel which is "1." A pixel pattern is not matched with the pixel whose pixel value is "0." In this way, a pixel pattern is assigned to the matched picture element position, respectively. So to speak, it is drawing 1 (b). If the shown arrangement is compared to a wall, the work which sticks one tile as shown in drawing 2 at a time on "1" in this wall and each drawn field will be done. As a result, an image pattern as shown in drawing 3 is obtained. This image pattern is a pattern eventually recorded on a diffraction grating recording medium. Drawing 1 (a) Although the shown motif is expressed as it is, each pixel comprises a diffraction grating and the visual effect as a diffraction grating will be acquired.

[0027]In the above, although the fundamental example which assigns a diffraction grating pattern by a pixel unit was explained, the conventional technique for expressing two or more motifs is explained. Since the diffracted light obtained from a diffraction grating has directivity, it is unobservable depending on an observation direction. Therefore, if the pixel patterns P1 (grid line arrangement angle of 45 degrees) and P2 (grid line arrangement angle of 90 degrees) which differed in the arrangement angle of the grid line are assigned on the same medium for example, as shown in drawing 4, Only the pixel pattern P1 will be observed from a certain observing angle, and only the pixel pattern P2 will be observed from another observing angle. Then, if the pixel pattern P1 expresses the motif A and the pixel pattern P2 expresses the motif B, It becomes possible to form the recording medium that two different motifs can be expressed on the same flat surface, the motif A is moreover observed from a certain observing angle, and the motif B is observed from another observing angle. This is the basic technique for expressing several different motifs on the same medium.

[0028]However, in expressing two motifs in which pixels overlap mutually on the same medium, a certain device is needed. For example, drawing 5 (a) (b) With the application of the above-mentioned basic technique as it is, work is done to the two motifs A and B as shown. The pattern P1 shown in drawing 4 about the motif A is made to correspond, and the pattern P2 shown in drawing 4 is made to correspond about the motif B here. Then, about the motif A, it is drawing 6 (a). The correspondence relevant information R1 as shown is created, and it is drawing 6 (b) about the motif B. The correspondence relevant information R2 as shown is created. However, if it tries to do the work which actually assigns a pixel pattern based on these two correspondence relevant information R1 and R2, the collision of a pixel pattern will arise about the pixel enclosed as the solid line to drawing 6. For example, if it sees about two-line the pixel of the 4th row, according to the correspondence relevant information R2, assigning the pixel pattern P2 is shown to assigning the pixel pattern P1 being shown according to the correspondence relevant information R1. It becomes impossible for this reason, to judge which pixel pattern should be assigned actually.

[0029]Then, this problem is solved by conventionally introducing the concept of a sub-picture element. For example, drawing 5 (a) (b) When the predetermined motif is expressed by shown seven-line the pixel arrangement of seven rows, If each pixel is divided into two-line the sub-picture element of two rows, the sub-picture element of the upper left and the lower right expresses the motif A and the sub-picture element of the lower left and the upper right expresses the motif B, even if both motifs lap, by a pixel unit, it will be lost that both motifs lap per sub-picture element. Drawing 7 (a) (b) The pixel pattern arrangement to such a sub-picture element is shown. Each rectangle surrounded as the solid line is a pixel here, and the small rectangle quadrisected and obtained in this pixel as a dashed line shows is a sub-picture element. Drawing 7 (a) In order to express the motif A, in the motif A, a pixel value about the pixel (pixel expressed with black to drawing 5 (a)) which is "1." the state where the pixel pattern P1 with a grid line arrangement angle of 45 degrees was assigned to the upper left in the pixel and a lower right sub-picture element is shown -- drawing 7 (b). In order to express the motif B, in the motif B, a pixel value shows the state where the pixel pattern P2 with a grid line arrangement angle of 90 degrees was assigned to the lower left in the pixel, and an upper right sub-picture element, about the pixel (pixel expressed with black to drawing 5 (b)) which is "1." Drawing 7 (a) The sub-picture element to which

it set and the pixel pattern was assigned, and drawing 7 (b) Since it does not come to the position in which the sub-picture element to which it set and the pixel pattern was assigned is by no means the same, a diffraction grating recording medium as shown in drawing 8 can be obtained by piling both up.

[0030]In the diffraction grating recording medium shown in this drawing 8, the motif A and the motif B will overlap and will be expressed. By and the sub-picture element expressing the motif A and the sub-picture element expressing the motif B. since the formation angles of a grid line differ, if it observes from a certain direction whose number is one, the motif A can be recognized (a pattern like drawing 7 (a) can be recognized), and the motif B can be recognized if it observes from another direction -- it is like (a pattern like drawing 7 (b) can be recognized). If such a technique is used, it will become possible to overlap on the same flat surface and to express about two or more motifs in which a pixel overlaps.

[0031]However, it is as having already stated that there is a problem that luminosity and image quality deteriorate in the technique using such a sub-picture element. For example, the motif A and drawing 7 (a) which were expressed by the usual pixel as shown in drawing 3 If the motif A expressed by the sub-picture element is compared so that it may be shown, It turns out that the area from which the diffracted light is obtained in the latter is half [former], and luminosity falls to a half on the whole. If the size of each pixel is compared, to the former pixel, as for the latter pixel, a size is set to one fourth, a diffraction grating effective area will be small and luminosity will fall further. Although it is considered as the technique of carrying out the duplicate record of two or more motifs and the method of thinning out a pixel is also indicated by explanation of drawing 28 of the Japanese-Patent-Application-No. No. 148681 [five to] specification, without making the size of each pixel small, if a pixel is thinned out, degradation of image quality will not be avoided. This invention provides the new technique for solving such a conventional problem. Hereafter, the technique of this invention is explained in full detail.

[0032]**2. the diffraction grating recording medium concerning this invention -- here -- drawing 5 (a) (b) The technique concerning this invention is explained taking for an example the case where the two motifs A and B as shown are recorded. In the technique concerning this invention, as shown in drawing 9, three kinds of pixel patterns are prepared. The pixel pattern P1 and P2 are completely the same as the pixel pattern used by the conventional technique explained by above-mentioned Section1. The pixel pattern P1 (grid line arrangement angle of 45 degrees) is a pattern for expressing the motif A, and the pixel pattern P2 (grid line arrangement angle of 90 degrees) is a pattern for expressing the motif B. In this invention, the multiplex pixel pattern P12 is prepared further. This multiplex pixel pattern P12 is the pixel pattern P1 and a pattern on top of which P2 was laid.

It is a pattern which has stationed the both sides of a grid line with an arrangement angle of 45 degrees which exists in the pixel pattern P1, and a grid line with an arrangement angle of 90 degrees which exists in the pixel pattern P2.

Thus, the diffraction grating which has two kinds of grid lines with which direction differs is made to call it a multiplex diffraction grating.

[0033]Under the usual lighting environment, the diffraction grating recording medium with which the pixel pattern P1 was formed looks bright, when it observes from the observation direction D1 shown in the lower berth of drawing 9, and the diffraction grating recording medium with which the pixel pattern P2 was formed looks bright when it observes from the observation direction D2 shown in the lower berth of drawing 9. However, the multiplex pixel pattern P12 has served as and offered the character of the both.

It looks brightly even if it observes from the observation direction D1 and which direction of D2.

Then, the pixel pattern P1 is assigned about the pixel which constitutes the motif A, It is possible to express both patterns, without using a sub-picture element, if the pixel pattern P2 is assigned about the pixel which constitutes the motif B and the multiplex pixel pattern P12 is assigned about the pixel which constitutes the both sides of the motif A and the motif B.

[0034]Specifically, it is drawing 5 (a). (b) What is necessary is to prepare correspondence relevant information as shown in drawing 10, and just to assign three kinds of pixel patterns P1 shown in drawing 9, P2, and P12 based on this correspondence relevant information, in order to express both motifs A and B as shown. Drawing 11 shows the diffraction grating recording medium produced by performing such allotment. With this diffraction grating recording medium, it is drawing 5 (a). In the picture element position shown black in the shown motif A, the grid line with an angle of 45 degrees is always arranged.

The motif A will be observed if it observes from the observation direction D1 shown in drawing 9.

On the other hand, it is drawing 5 (b). In the picture element position shown black in the shown motif B, the grid

line with an angle of 90 degrees is always arranged.
The motif B will be observed if it observes from the observation direction D2 shown in drawing 9.

[0035]According to the method of using such a multiplex diffraction grating as a pixel, the problem of the deterioration of luminosity like a method or image quality which uses the conventional sub-picture element is solved. For example, the motif A expressed by the usual pixel as shown in drawing 3. If the motif A expressed by the pixel containing a multiplex pixel pattern is compared as shown in drawing 11, as for the area from which the diffracted light is obtained in a predetermined observing angle, similarly [both], the shape of a pixel will become a rectangle with perfect both. therefore -- theoretical -- luminosity and image quality -- both persons -- it becomes the same and stops producing at all a problem like the method of using a sub-picture element However, compared with the former, the latter luminosity falls a little actually. It is because this is physically difficult to form the ideal multiplex diffraction grating which serves as the pixel pattern P1 and the both sides of P2 since it is necessary to form physical rugged structure when forming the multiplex pixel pattern P12 shown in drawing 9 on a actual recording medium. Although a physical structure of this multiplex diffraction grating is explained in full detail behind, The luminosity obtained in a actual multiplex diffraction grating when the multiplex pixel pattern P12 is observed from the observation direction D1, The luminosity obtained when it falls a little rather than the luminosity obtained when the pixel pattern P1 is observed from the same observation direction D1 and the multiplex pixel pattern P12 is observed from the observation direction D2 falls a little rather than the luminosity obtained when the pixel pattern P2 is observed from the same observation direction D2. However, if compared with the method of using a sub-picture element like before, luminosity with the more sufficient method of using the multiplexed pattern concerning this invention will be obtained.
[0036]**3. The fundamental concept of condition this invention as a multiplex diffraction grating is at the point which carries out multiplex recording of two or more motifs using the multiplex diffraction grating which recorded two kinds of grid lines with which direction differs in the same closed region. However, by such a multiplex diffraction grating, in order to make usable diffraction phenomena start, specific conditioning is needed. An invention-in-this-application person is drawing 12 (a). The diffraction grating whose grid line arrangement angle as shown is 0 degree, Drawing 12 (b) Multiplex recording of the diffraction grating whose grid line arrangement angle as shown is 90 degrees was carried out, and when the lattice as shown in drawing 13 was made as an experiment, even if it observed from what kind of observation direction, the diffracted light was not able to be observed at all. Drawing 12 (a) The shown diffraction grating is also drawing 12 (b). The shown diffraction grating is also a former very generally used standard diffraction grating. That is, any diffraction grating has the width dL of the line L, and the equal width dS of the space S, and is a diffraction grating with the becoming conditions dL:dS=1:1.
[0037]Thus, although diffraction phenomena were not seen at all with the lattice produced by piling up two kinds of diffraction gratings with the conditions "dL:dS=1:1" [very standard] Becoming, the invention-in-this-application person found out that diffraction phenomena arose by changing from 1:1 the ratio "dL:dS" Becoming. For example, diffraction phenomena arise in the lattice produced by piling up two kinds of diffraction gratings with the conditions "dL:dS=1:2" Becoming. Namely, drawing 14 (a) The diffraction grating whose grid line arrangement angle as shown is 0 degree, Multiplex recording of the diffraction grating whose grid line arrangement angle as shown in drawing 14 (b) is 90 degrees is carried out, The diffracted light has been observed also when the lattice as shown in drawing 15 was made as an experiment, and a lengthwise direction (direction which the diffracted light about the diffraction grating shown in drawing 14 (a) can observe), and a transverse direction (direction which the diffracted light about the diffraction grating shown in drawing 14 (b) can observe) observed either. However, the luminosity of the diffracted light observed about this multiplex diffraction grating becomes a little darker than the diffracted light observed about the diffraction grating (diffraction grating shown in drawing 14 (a) and (b)) of the basis.
[0038]In order to find out the critical condition about the ratio "dL:dS" [for forming a multiplex diffraction grating] Becoming, when it experimented by changing various this ratio, it has checked "dL:dS=1:2" That the becoming conditions were critical conditions for obtaining the diffracted light within limits which an artificer recognizes. That is, they are dS>=2 and dL (basal condition) between the linewidth dL and the space width dS. If two kinds of diffraction gratings with the grid line that the becoming relation is obtained are piled up, a multiplex diffraction grating will be obtained. Of course, since it is diffraction phenomena of light, it cannot be overemphasized that the pitch p of a grid line (p=dL+dS) needs to have the length near the wavelength of light. "dL:dS=1:2" Although the theoretical analysis about the reason which becomes a critical condition for the

becoming conditions to form a multiplex diffraction grating is not conducted at a present stage, this ratio is 1:2 or more.
If only the pitch p is a pitch which causes diffraction, the invention-in-this-application person thinks that a multiplex diffraction grating can be formed.
if an extreme example is shown -- even if -- "-- the pitch from which the pitch p starts diffraction even if it is dL:dS=1:infinite" -- it is even -- if it carries out, it can be expected that a multiplex diffraction grating can be formed. But "1: In order to realize the ratio infinite", it is impossible for it to be necessary to make it linewidth dL=0, and to form such a multiplex diffraction grating actually. However, if the line L formed on the actual medium has a function in which the line L covers light even if it is sufficient if it functions as a shelter of light, and the linewidth dL approaches zero infinite, it is possible to form the multiplex diffraction grating concerning this invention.
[0039]Although the linewidth dL is a diffraction grating with the equal space width dS equally and mutually mutually, two kinds of diffraction gratings with these equal do not necessarily need to be used for two kinds of diffraction gratings (diffraction grating shown in drawing 14 (a) and (b)) which became a basis of the multiplex diffraction grating shown in drawing 15. in each diffraction grating -- dS>=2 and dL (basal condition) -- if the relation is obtained, even if it piles up two kinds of diffraction gratings with mutually different linewidth dL and the space width dS, it is possible to obtain a multiplex diffraction grating.
[0040]By the way, although the multiplex diffraction grating shown in drawing 15 is shown as a monochrome pattern, the multiplex diffraction grating actually formed on a medium becomes a structure with detailed rugged structure. For example, in the monochrome pattern shown in drawing 15, the sectional side elevation of the multiplex diffraction grating recording medium 80 which makes heights a black portion (namely, portion of the line L), and makes a crevice a white portion (portion of square space SS which had the neighborhood surrounded by the line L) is shown in drawing 16. Here, the portion of space SS forms the hollow 85, light will enter into this hollow 85, diffraction phenomena will happen, and the portion of the line L will function as the shield wall 86 over this incident light (as mentioned above). As long as it has a function as the shield wall 86, 0 may be theoretically sufficient as thickness. But conversely, in the monochrome pattern shown in drawing 15, even if it creates a diffraction grating recording medium which makes a black portion a crevice and makes a white portion heights, it functions as the rugged structure shown in this drawing 16 as a multiplex diffraction grating. However, practically, as shown in drawing 16, make a black portion (line part) into heights, and let a white portion (space portion) be a crevice. (practical use conditions 1)
** is preferred. Because, according to the basal condition as for which dS>=2 and dL become, since the direction of the width dS of a white portion becomes more than twice as long as the width dL of a black portion, It is because it can become depressed, the light it is more to have become depressed considering the white portion as a crevice, and to form 85 can be incorporated in 85 and more diffracted light can be obtained now.
[0041]In the structure shown in drawing 16, in order to make diffraction phenomena start about the light of the predetermined wavelength lambda, it is necessary to take the larger width dS of the hollow 85 than the wavelength lambda, i.e., space width. The light with larger wavelength than the space width dS is because it cannot enter in the hollow 85 and does not diffract. However, the diffracted light of an ultraviolet area or an infrared region is unnecessary as a diffraction grating recording medium which human being observes. Therefore, as conditions as a practical diffraction grating recording medium, it is about the visible wavelength lambda further. DS>lambda (practical use conditions 2)
The conditions to say are needed.
[0042]By the way, when using a diffraction grating recording medium as a seal for forgery prevention, it is common that a specific observing angle becomes settled. Usually, as shown in drawing 16, it is common to observe from within the limits of **45 degrees to the normal stood to the surface of the medium 80. For example, if it uses as a seal for forgery prevention for a credit card, it is common to determine the angle which inclined to the front about 30 degrees to the normal stood on the surface of the credit card as a temporary observing angle. Let this observing angle be the most natural observing angle when a credit card is gained.
[0043]Thus, if a specific observing angle can be defined, the more desirable conditioning as a diffraction grating recording medium is possible. For example, light enters into the upper surface of the multiplex diffraction grating recording medium 80 from the vertical upper part, and conditions for this light to diffract in the predetermined observing angle theta direction are given by Bragg's equation p-sin theta=n lambda. Here, p is a pitch of a diffraction grating and, in the case of this invention, is p= (dS+dL). theta is an observing angle (angle with the normal stood to the medium surface to make), as mentioned above, and the wavelength of the light by which

lambda is observed, and n are the degrees (n= 1, 2 and 3, --) of the diffracted light obtained. It will be preferred to use the practically brightest primary diffracted light, and it will set to n= 1. Therefore, as a conditional expression of a multiplex diffraction grating recording medium more practical than the formula of the above-mentioned black, it is -(dS+dL) sin theta=lambda. (practical use conditions 3)
The becoming formula is obtained.
[0044]It is as follows when the basal condition for obtaining a multiplex diffraction grating recording medium and practical use conditions required since this is put in practical use are summarized after all.
<Basal condition> dS>=2 and dL <practical use conditions 1> line part Heights, The <practical use condition 2> visible wavelength lambda which makes a space portion a crevice As a concrete example of dS>lambda <practical use conditions 3> and (dS+dL) sin theta=lambda this invention, they are dL=0.4micrometer and dS=0.8micrometer (pitch of p= 1.2 micrometers).
theta= 30 degrees (sintheta = 1/2)
lambda= 0.6 micrometer (visible wavelength)
Becoming setting out is performed. It is dS=2 and dL and the basal condition is satisfied, and it is dS>lambda and satisfied with this setting out of the practical use conditions 2. It became = [-(dS+dL) sintheta] (0.4micrometer+0.8micrometer) and 1/2=0.6 micrometer=lambda, and the practical use conditions 3 are also satisfied. Therefore, according to above-mentioned setting out, it is possible to create the practical multiplex diffraction grating recording medium with which it was satisfied of the conditions of all above.
[0045]**4. Explain the drawing method of a multiplex diffraction grating pattern, then the method of forming the multiplex diffraction grating pattern concerning this invention on a medium. As shown in drawing 16, the multiplex diffraction grating recording medium 80 concerning this invention is a medium which had rugged structure in the surface. When creating such a medium, it is common to create first the original edition which rugged structure reversed, and to mass-produce a medium by press working of sheet metal using this original edition. In order to create the original edition, a regist layer is formed on an original edition composition layer, and after patterning after a pattern as shows drawing 15 this regist layer, the exposed part of an original edition composition layer will be etched. However, generally the pattern of a diffraction grating is difficult to perform exposure to a regist layer using a photo mask, since linewidth dL and the space width dS are the minute patterns of submicron order. Therefore, the method of usually exposing a regist layer directly using an electron beam is taken.
[0046]As well as the case where the conventional common diffraction grating original edition is created when creating the original edition of the multiplex diffraction grating concerning this invention, the regist layer is exposed using the electron beam. Conventionally, it is drawing 14 (a). Or (b) The electron beam was scanned based on image data as shown, and monochrome pattern which is illustrated on a regist layer was formed. That is, the black field equivalent to the line L is irradiated with a beam, and it is considered as an exposure part. Therefore, what is necessary is to scan an electron beam based on image data as shown in drawing 15, and just to form monochrome pattern on a regist layer in this invention.
[0047]However, it is common to take the method which specifies a drawing object as a set of square graphic data in the electron beam exposure system marketed now. If another word is carried out, the common electron beam exposure system has only the function which scans an electron beam in the field in the quadrangle which connects these four vertices based on four given apex-coordinates values. Such an electron beam exposure system is used and it is drawing 14 (a). Or it is easy to draw the usual diffraction grating pattern as shown in (b). That is, since the 1 one line L is a very long and slender quadrangle with the width dL, if the four apex-coordinates values are given to an electron beam exposure system, it can draw this. However, a device is somewhat required in order to draw the multiplex diffraction grating pattern concerning this invention as shown in drawing 15. In order to make it draw with a common electron beam exposure system, it is necessary to divide this multiplex diffraction grating pattern into some quadrangles.
[0048]As one method, it is drawing 14 (a) about the pattern shown in this drawing 15. A pattern and drawing 14 (b) How to divide into a pattern can be considered. Namely, drawing 14 (a) After drawing the shown pattern, it is drawing 14 (b). If the shown pattern is drawn in piles, the pattern shown in drawing 15 will be obtained. However, with this method, it is drawing 17 (a). As hatching was performed and shown, in crossing area CC of the two lines L, double drawing will be performed and it is not desirable. That is, an electron beam will be irradiated twice by the regist layer corresponding to this crossing area CC, and a light exposure doubles compared with the portion of the usual line L. For this reason, when a regist layer is developed, a difference will arise into the portion of the usual line L, and the portion of crossing area CC. Since such a difference is not produced, it is drawing 17 (b). One line L can be divided in a crossing portion, the quadrangle of a large number which do not overlap,

respectively can be defined, and the method of exposing every four square shapes can also be taken so that it may be shown. However, in such a method, since the adjoining distance between quadrangles becomes very small, when performing the process of the exposure/development to a regist layer, it is easy to produce trouble.
[0049]So, in this example, the electron beam lithography is performed by the following methods. That is, black and white of the multiplex diffraction grating pattern shown in drawing 15 are reversed, and a negative pattern as shown in drawing 18 is formed. The portions of white and square space SS are black expressed for the portion of the line L by this negative pattern. And the field of square space SS expressed with this black is made to draw with an electron beam. Each portion of space SS is a quadrangle and it can draw easily only by giving four apex-coordinates values of this quadrangle to an electron beam exposure system.
[0050]Such display-in-white processing ends only by processing in which "0" is replaced with "1", when the pattern is expressed as binary raster image data. However, as for a pattern, in order to reduce data volume, expressing as vector data is preferred. In this case, what is necessary is just to perform the following processings. First, drawing 14 (a) (b) The shown pattern is prepared, respectively as topographic contour plot form data (vector data) which expressed the border line of the space area (white field of a figure) between grid lines with the quadrangle. And what is necessary is just to obtain the topographic contour plot form data which performed the logical operation between these two topographic contour plot form data, and expressed the crossing area of four square shapes each with a new quadrangle (the white field of drawing 15, or the black field of drawing 18).
[0051]By the way, to use the negative pattern shown in drawing 18 instead of the pattern shown in drawing 17, the exposed part by an electron beam needs to use the negative resist which remains by development as a regist layer. Order is explained later on for every stage, referring to the sectional side elevation of drawing 19 - drawing 23 for the process of creating the original edition using such negative resist, hereafter.
[0052]First, as shown in drawing 19, the original edition composition layer 2 is formed on the substrate 1, and the regist layer 3 of a negative mold is formed on it. In this example, the metal layer (for example, copper) is used as the original edition composition layer 2, using a glass substrate as the substrate 1. Then, an electron beam is scanned based on a negative pattern as shown in drawing 18, and only the field of space SS of the quadrangle black shown in the figure is exposed. By this, as shown in drawing 20, on the regist layer 3, the exposure part 3a and the non-exposed area 3b will be formed. The exposure part 3a is a portion equivalent to the black field in drawing 18, and the non-exposed area 3b is a portion equivalent to the white field in drawing 18. Then, since it is the resist of a negative mold when development to resist is performed, the non-exposed area 3b will be eluted and will be removed, and as shown in drawing 21, only the exposure part 3a will remain. Then, etching to the original edition composition layer 2 is performed, using this exposure part 3a that remained as a mask. Then, as shown in drawing 22, etching removal of the exposed part of the original edition composition layer 2 will be carried out, and the residual layer 2a and the exposure part 3a will remain only in the field equivalent to square space SS. When mass-producing a diffraction grating recording medium with the technique of a press, the structure shown in this drawing 22 can be used as the original edition 60 as it is. Of course, after this, the strip of the resist (exposure part 3a) may be carried out, and the structure shown in drawing 23 may be used as the original edition 60. Such the original edition 60 is the original edition in which the portion of square space SS makes convex. Therefore, if it carries out like a press operator using this original edition, a multiplex diffraction grating recording medium as shown in drawing 16 can be created.
[0053]By the way, as Section2 was already described, in this invention, a motif will be expressed by assigning various pixel patterns as shown in drawing 9 to a predetermined picture element position. Although the line L is lengthened and the predetermined angle shows the expedient top of explanation, each pixel pattern P1, P2, and P12 in the predetermined picture element region at drawing 9, these lines L or the space S all becomes a quadrangle actually. Drawing 24 is the figure in which three kinds of pixel patterns P1 shown in drawing 9, P2, and P12 emphasized and showed the point constituted by the square line L and the space S. in order to satisfy the basal condition mentioned above for this example -- the ratio of the linewidth dL and the space width dS -- it is set as dL:dS=1:2. As a concrete dimension value, in this example, since it is dL=0.4micrometer and dS=0.8micrometer and the size of 1 pixel is 45 micrometers x 50 micrometers, or 50 micrometers x about 50 micrometers, many lines L and spaces S will be formed more in one picture element region.
[0054]As mentioned above, as drawing indication given to an electron beam exposure system, it is common to use square 4 apex-coordinates value. And in the electron beam exposure system generally used. As shown in a figure, when XY two-dimensional coordinate system is defined and a parallelogram to which two sides become parallel to the X-axis, or two sides make a parallelogram which becomes parallel to a Y-axis draw, it becomes

possible to do very efficient drawing work, and there is character in which drawing time is also shortened. So, in this example, as the portion which constitutes the spaces S and SS is expressed with one of the parallelograms mentioned above and the coordinate value of the four peaks is given to an electron beam exposure system, efficient drawing is enabled.

[0055]For example, he gives 4 apex-coordinates value of the parallelogram ABCD of a figure to an electron beam exposure system, and is trying to draw the field of the space S which performed and showed slash hatching in the figure in the pixel pattern P1. When saying strictly, the field T which performed and showed hatching by a dot in the figure was a field which should draw essentially, but in order to make it the parallelogram ABCD with two sides parallel to the X-axis serve as a depiction area given to an electron beam exposure system, the field T was excepted from the depiction area. Thus, about some fields near the outline, since it excepts from a drawing object and two sides defined the depiction area of the pixel pattern P1 only with the parallelogram parallel to the X-axis, very efficient drawing is attained.

[0056]He gives 4 apex-coordinates value of the parallelogram ABCD of a figure (in practice rectangle) to an electron beam exposure system, and is trying to draw the field of the space S which performed and showed slash hatching in the figure in the pixel pattern P2. Thus, since all the fields of the space S become a rectangle when a grid line arrangement angle is 90 degrees or 0 degree, it is not necessary to provide the field excepted from a drawing object.

[0057]He gives 4 apex-coordinates value of the parallelogram ABCD of a figure to an electron beam exposure system, and is trying to, draw the field of space SS of the quadrangle which performed and showed slash hatching in the figure with the multiplexed pattern P12 on the other hand. In this case, since space SS of the quadrangle which performed and showed slash hatching in the figure becomes a parallelogram with two sides parallel to a Y-axis, too efficient drawing is attained. Although space TT (hatching by a dot is performed and shown in a figure) which carried out the irregular form near the outline was also a field which should draw essentially, since it became a factor which reduces drawing efficiency, it was excepted from the drawing object.

[0058]Although the field of the spaces T and TT emphasizes and is drawn in drawing 24, since these fields are some [mere] fields near the outline, even if it excepts from a drawing object, trouble is not produced at all practically actually.

[0059]**5. An example of the device for creating efficiently the preparation device of the diffraction grating recording medium concerning this invention, then the diffraction grating recording medium mentioned above is shown. Drawing 25 is a block diagram showing one example of the preparation device of the diffraction grating recording medium concerning this invention. Here, the motif image data input device 10 is a device for inputting the image data about a motif as shown in drawing 5 into the workstation 20. For example, what is necessary is just to use a scanner device as this motif image data input device 10, if motif image data is inputted based on the pattern of the motif drawn on space. Or what is necessary is just to use a floppy disk drive device as this motif image data input device 10, for example, if motif image data is inputted based on the pattern drawn by the graphics software using a computer.

[0060]The workstation 20 is a computer which carries the program for performing processing which assigns a predetermined pixel pattern to each pixel of the inputted motif, or performing processing which piles up two pixel patterns and creates a multiplex pixel pattern.

Output equipment, such as input devices, such as a keyboard and a mouse, and a display, and a printer, is connected.

The memory storage 30 is external storages connected to this workstation 20, such as a floppy disk drive device and a hard disk drive apparatus. In this memory storage 30, indicative data with a field, assignment indicative data, pixel pattern information, and multiplex pixel pattern information are saved. The contents of each of these data are mentioned later.

[0061]On the other hand, the format conversion system 40 is a device with the function to change the indicative data with a field, the assignment indicative data, pixel pattern information, and multiplex pixel pattern information which are given from the workstation 20 into the drawing data which suited the format which the electron beam exposure system 50 requires. The data by which format conversion was carried out is given to the electron beam exposure system 50 as drawing data. As Section4 described, this drawing data is a set of the coordinate value of four vertices of the quadrangle which constitutes a depiction area. In this way, by the electron beam exposure system 50, drawing of a up to [a regist layer] is performed and the diffraction grating record original edition 60 is created. The press device 70 is a device which presses a diffraction grating pattern on a film using this diffraction grating record original edition 70.

The diffraction grating recording medium 80 will be mass-produced by this press working of sheet metal.

[0062]In this device, various image data which forms a diffraction grating pattern is dealt with as data with a layered structure. First, the motif inputted from the motif image data input device 10 is divided to two or more fields in the workstation 20 if needed. For example, as shown in drawing 26, the field on which the motif was drawn should be divided into the four fields A1 - A4. At this time, the indicative data with a field in which it is shown whether field attachment of each field should be carried out at which position is created. In this example, the position of the lower left corner of each field is used as indicative data with a field. That is, field attachment of the field A1 - A4 will be carried out so that a lower left corner may come to the position of the points Q1-Q4, respectively. This example defines the accessories field A0 which displayed the position information U required for the processes other than the field A1 - A4 that the original motif was displayed, such as alignment (what is called a dragonfly). In addition to this, a serial number etc. can be described in the accessories field A0, and process control information required for a next process in short can be recorded on it.
[0063]In this way, after performing area division, processing which creates assignment indicative data is performed for every field. For example, when assigning the two motifs A and B as shown in drawing 5 in the field A1, correspondence relevant information as shown in drawing 10 will be prepared as assignment indicative data. In the memory storage 30, the pixel pattern P1 as shown in drawing 9, P2, and the multiplex pixel pattern P12 are prepared. If you prepare in the memory storage 30 beforehand, are convenient, but it can be made to generate [pixel pattern / P12 / multiplex] by an operation about the pixel pattern P1 and P2 here if needed.
[0064]Here, the relation between assignment indicative data and pixel pattern information is considered. Pixel pattern information is data in which the pattern which constitutes one pixel is shown, as shown in drawing 9. Assignment indicative data is data which directs which pixel pattern is assigned to each picture element position like the correspondence relevant information shown in drawing 10.
Therefore, if pixel pattern information is considered to be data of the low order hierarchy of assignment indicative data, the drawing data eventually formed on a diffraction grating recording medium will be expressed by a younger hierarchy's pixel pattern information, and the older hierarchy's assignment indicative data. Considering having performed area division as shown in drawing 26, as the drawing data eventually formed on a diffraction grating recording medium is shown in drawing 27, it turns out a high order hierarchy's indicative data with a field, each assignment indicative data of a middle hierarchy, each pixel pattern information of a low order hierarchy, and that be alike is expressed.
[0065]Thus, if expression with a layered structure is performed, all the fields can be made to reduce data volume considerably compared with the case where the pattern information of a actual grid line is developed. For example, since many grid lines are formed in 1 pixel, this data about 1 pixel becomes most quantity, but if expression with a layered structure is performed, if only the number of pixel patterns prepares pixel pattern information, it is sufficient as a low order hierarchy's data.
[0066]In this way, in the workstation 20, a high order hierarchy's indicative data with a field, a middle hierarchy's assignment indicative data, and three kinds of hierarchy data of a low order hierarchy's pixel pattern information ** are created, and it is independently saved in the memory storage 30, respectively. And also to the format conversion system 40, each of these hierarchy data is given separately, with a layered structure having, and turns into data in which the drawing data which the format conversion system 40 outputs has also had a layered structure. The electron beam exposure system 50 which has spread now can perform drawing processing based on the drawing data which usually had such a layered structure. Therefore, image data can be dealt with as data with a layered structure, and efficient data processing becomes possible until it delivers data to the electron beam exposure system 50.
[0067]**6. The example described about one motif until now [example] using two or more pixel patterns was an example which uses one pixel pattern about one motif. Namely, drawing 5 (a) The pixel pattern P1 shown in drawing 9 about the shown motif A is used, and it is drawing 5 (b). About the shown motif B, the pixel pattern P12 shown in drawing 9 was used only for the pixel of the portion with which both patterns lapped using the pixel pattern P2 shown in drawing 9. However, it is also possible to use two or more pixel patterns about one motif. For example, in the example shown in drawing 28, three kinds of pixel patterns P4, P5, and P6 are used about the motif B, using three kinds of pixel patterns P1, P2, and P3 about the motif A. Six kinds of pixel patterns P1-P6 shown in this drawing 28 all differ in the arrangement angle of the grid line little by little. However, these six kinds of pixel patterns can be classified into the group who is two which the arrangement angle of a grid line approximates mutually. That is, the 1st group is the pixel patterns P1-P3 in which the grid line arrangement

angle was set up near 45 degree.
These are used about the motif A.
On the other hand, the 2nd group is the pixel patterns P4-P6 in which the grid line arrangement angle was set up near 90 degree.
These are used about the motif B.

[0068]Like 45 degrees and 90 degrees, the pixel pattern in which grid line arrangement angles differ extremely is not simultaneously observed, when it observes from a predetermined direction. However, also when it observes from a predetermined direction, the pixel pattern (for example, pixel patterns P1-P3 shown in drawing 28) only with about **5-degree angular difference which the grid line arrangement angle approximated mutually is observed simultaneously, and it deals in it. However, luminosities will differ a little mutually. The technique expressing the motif which had gradation in the Japanese-Patent-Application-No. No. 317274 [five to] specification using such character is indicated. For example, although "0" or "1" had not carried out a binary deer definition in the above-mentioned example as a pixel value of the pixel which constitutes the motif A, Define the pixel value of 8 bits expressed with 0-255, and the pixel pattern P1 is assigned about the pixel of the pixel values 0-100, If the pixel pattern P2 is assigned about the pixel of the pixel values 101-200 and the pixel pattern P3 is assigned about the pixel of the pixel values 201-255, it will become possible to express a motif with gradation. What is necessary is just to assign either of three kinds of pixel patterns P4-P6 similarly according to a pixel value about the motif B.
[0069]Thus, if this invention is applied to the method of assigning either of the pixel patterns P1-P3 about the motif A, and assigning either of the pixel patterns P4-P6 about the motif B, What is necessary is just to assign the multiplex pixel pattern on which each pixel pattern was piled up about the pixel which constitutes the both sides of both motifs. For example, what is necessary is just to assign the multiplex pixel pattern which can obtain the pixel patterns P1 and P5 in piles to the picture element position which needs to assign the pixel pattern P1 as a pixel of the motif A, and needs to assign the pixel pattern P5 in piles as a pixel of the motif B, respectively.
[0070]In the case of the example shown in drawing 28, the multiplex pixel pattern obtained with the combination of the pixel patterns P1-P3 for the motif A, and the pixel patterns P4-P6 for the motif B, There will be P14 (meaning of the combination of P1 and P4), P15, P16, P24, P25, P26, P34, P35, and nine kinds of P36. Therefore, if nine kinds of this multiplex pixel pattern is prepared, it will become possible to apply this invention. But nine kinds of this multiplex pixel pattern needs to prepare no multiplex pixel patterns beforehand, and what is necessary is just to make it generate them by an operation each time if needed, since it can be made to generate at any time by an operation based on the image data of the pixel patterns P1-P6 of a basis.
[0071]**7. The example described until now [example] records three or more motifs was an example which records two motifs called the motif A and the motif B in piles. Here, the example which records three or more motifs in piles is described. Now, as shown in drawing 29, about the motif A, the pixel pattern P1 (grid line arrangement angle of 0 degree) is used, About the motif B, the case where three kinds of motifs A, B, and C are recorded on a diffraction grating recording medium is considered [motif / C] using the pixel pattern P3 (grid line arrangement angle of 90 degrees) using the pixel pattern P2 (grid line arrangement angle of 45 degrees). Since the pixel pattern in which grid line arrangement angles differ extremely like 0 degree, 45 degrees, and 90 degrees is not simultaneously observed when it observes from a determined direction, according to an observation direction, the motif A, B, and C will be observed separately, respectively.
[0072]The basic principle of this invention is at the point of assigning a multiplex diffraction grating, about the pixel which constitutes two or more motifs. So, in recording such three motifs. As shown in the lower berth of drawing 29, the double diffraction grating P12, P23, and P13, Prepare the Mie diffraction grating P123 and the double diffraction grating P12 is assigned to the pixel which constitutes the both sides of the motifs A and B, What is necessary is to assign the double diffraction grating P23 to the pixel which constitutes the both sides of the motifs B and C, to assign the double diffraction grating P13 to the pixel which constitutes the both sides of the motifs A and C, and just to assign the Mie diffraction grating P123 to the pixel which constitutes all the three motifs A, B, and C further.
[0073]I will look at this about a concrete motif. Now and drawing 30 (a) (b) It considers recording three kinds of motifs A, B, and C as shown in (c) in piles on the diffraction grating recording medium of one sheet. In this case, drawing 30 (d) Correspondence relevant information as shown is obtained. The motif name which that pixel constitutes is shown by the alphabet in each pixel of this correspondence relevant information. What is necessary is here, just to assign the pixel pattern P1 shown in drawing 29, P2, and P3 to the pixel which the

single alphabet "A", "B", and "C" described, respectively. What is necessary is just to assign the double pixel pattern P12 shown in drawing 29, P23, and P13 to the pixel which the two alphabet "AB", "BC", and "CA" described, respectively. What is necessary is just to assign the Mie pixel pattern P123 shown in drawing 29 to the pixel (by a diagram, it has enclosed as the solid line) which the three alphabet "ABC" described.

[0074]Thus, if multiplex diffraction gratings, such as 4-fold [a duplex Mie, and] and --, are used, theoretically, it is possible to record any number of two or more motifs in piles. However, the technique of recording three or more motifs in piles by such a method is inapplicable practically. Because, a double diffraction grating like the multiplex pixel pattern P12, P23, and P13 is dramatically difficult to realize a Mie diffraction grating like the multiplex pixel pattern P123, or four-fold or more diffraction grating, although it is realizable by satisfying the conditions described by Section3. As a matter of fact, although the Mie diffraction grating P123 was made as an experiment, practically sufficient diffracted light was not able to be obtained from any observation direction. Of course, if specific conditioning is performed, a possibility that the practical Mie diffraction grating P123 can be created cannot be denied, but at present, such conditions are not found out.

[0075]Then, the invention-in-this-application person invented the new method of recording three or more motifs in piles by using together a double diffraction grating and a sub-picture element. First, each pixel which constitutes the motif shown in drawing 30 is quadrisected, respectively, and the sub-picture element arranged by two rows of two lines is defined. And drawing 30 (d) Based on the alphabet described in each pixel of the shown correspondence relevant information, as shown in drawing 31, the pixel pattern P1, P2, P3 or the multiplexed pattern P12, P23, and P13 are assigned in each sub-picture element. For example, what is necessary is just to assign the pixel pattern P1 to all of each sub-picture element which quadrisected this about the pixel which the single alphabet "A" described. Similarly about the pixel which the single alphabet "B" described. What is necessary is to assign the pixel pattern P2 to all of each sub-picture element which quadrisected this, and just to assign the pixel pattern P3 to all of each sub-picture element which quadrisected this about the pixel which the single alphabet "C" described.

[0076]About the pixel which the two alphabet "AB" described, the pixel pattern P1 is assigned to the upper left of each sub-picture element which quadrisected this, and a lower right sub-picture element, and the pixel pattern P2 is assigned to the sub-picture element of the lower left and the upper right. Or the multiplex pixel pattern P12 is assigned to all of each quadrisected pixel. It is preferred to assign the latter, when raising luminosity. The allotment about the pixel which the pixel which the two alphabet "BC" described, and "CA" described is also completely the same.

[0077]About the pixel which the three alphabet "ABC" described, the multiplex pixel pattern P13 is assigned to the upper left of each sub-picture element which quadrisected this, and a lower right sub-picture element, and the multiplex pixel pattern P12 is assigned to the sub-picture element of the lower left and the upper right. Or it may assign combining the multiplex pixel patterns P12 and P13, and may assign combining the multiplex pixel patterns P13 and P23. Of course, any multiplex pixel pattern may be assigned to any position of a sub-picture element. If such allotment is performed, in the pixel which the three alphabet "ABC" described, Even if it is not all the fields of a pixel, three grid lines of the grid line whose arrangement angle is certainly 0 degree, the grid line whose arrangement angle is 45 degrees, and the grid line whose arrangement angle is 90 degrees will exist, and it can serve as three, the pixel pattern P1, P2, and P3.

[0078]The same technique can be used also when recording four motifs in piles. Namely, about the pixel with which two or three motifs lapped among the four motifs A, B, and C and D. About the pixel with which what is necessary is just to have performed allotment as shown in drawing 31, and all the four motifs lapped. As shown in drawing 32, to each quadrisected sub-picture element For example, the multiplexed pattern P12 (pattern obtained by piling up the pixel pattern about the motif A, and the pixel pattern about the motif B), What is necessary is just to assign the multiplexed pattern P34 (pattern obtained by piling up the pixel pattern about the motif C, and the pixel pattern about the motif D).

[0079]So that one pixel may be divided into two or more sub-picture elements and the grid line arranged with the grid line arrangement angle of the pixel pattern matched with the motif which the pixel constitutes may appear in at least one sub-picture element in short, If a pixel pattern or a multiplex pixel pattern is assigned to each sub-picture element, it will become possible to record three or more motifs in piles. Of course, this technique is applicable also to the example using two or more pixel patterns about one motif, as Section6 described.

[0080]As mentioned above, although it explained based on some examples illustrating this invention, this invention is not limited to these examples and is feasible in various modes.

[0081]
[Effect of the Invention]According to a diffraction grating recording medium applied to this invention as above, and a preparation method for the same, since the multiplex diffraction grating expressed two or more motifs, even if it expresses two or more motifs in piles, the diffraction grating recording medium with which luminosity and image quality do not deteriorate is realizable.

[Translation done.]

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1]A diffraction grating recording medium recording both sides of the 1st grid line that turned to the 1st direction, and the 2nd grid line that turned to the 2nd direction in the same closed region in a diffraction grating recording medium which expressed a predetermined motif by a diffraction grating.
[Claim 2]A diffraction grating recording medium using a grid line that a relation dS>=2 and dL come [a relation] between the linewidth dL and the space width dS is obtained in the diffraction grating recording medium according to claim 1.
[Claim 3]A diffraction grating recording medium constituting in the diffraction grating recording medium according to claim 2 so that a line part of a grid line may make heights and a space portion may make a crevice.
[Claim 4]A diffraction grating recording medium using a grid line with the space width dS with which it is satisfied of a formula as for which dS>lambda becomes to the predetermined visible wavelength lambda in the diffraction grating recording medium according to claim 3.
[Claim 5]A diffraction grating recording medium using a grid line with the linewidth dL and the space width dS with which it is satisfied of a formula which defines the predetermined observing angle theta in the diffraction grating recording medium according to claim 4 to a normal stood to a recording medium surface, and as for which -(dS+dL) sin theta=lambda becomes.
[Claim 6]In a diffraction grating recording medium which expressed two or more motifs by a diffraction grating, The 1st pixel pattern that arranges many 1st grid line that turned to the 1st direction in a pixel closed region, The 2nd pixel pattern that arranges many 2nd grid line that turned to the 2nd direction in a pixel closed region, A multiplex pixel pattern which stations many both sides of the 1st grid line and the 2nd grid line in a pixel closed region, Give a definition and said 1st pixel pattern is assigned to a pixel which constitutes only the 1st motif, A diffraction grating recording medium having assigned said 2nd pixel pattern to a pixel which constitutes only the 2nd motif, and assigning a multiplex pixel pattern to a pixel which constitutes both sides of the 1st motif and the 2nd motif.
[Claim 7]In a diffraction grating recording medium which expressed two or more motifs by a diffraction grating, A pixel pattern which arranges many grid lines in a predetermined pixel closed region, By changing an arrangement angle of a grid line, define more than one and a pixel pattern of these plurality, It divides into two or more groups by making into one group a pixel pattern which an arrangement angle of a grid line approximates mutually, One group is matched about each of two or more motifs which should be expressed, A multiplex pixel pattern obtained by arranging in piles a grid line arranged at each in the same pixel closed region about two pixel patterns which belong to a different group is defined, To a pixel which assigns a pixel pattern which belongs to a group matched with the motif to a pixel which constitutes only a single motif, and constitutes two motifs. A diffraction grating recording medium assigning a multiplex pixel pattern in which a pixel pattern which belongs, respectively was defined as two groups matched with each motif.
[Claim 8]In a diffraction grating recording medium which expressed two or more motifs by a diffraction grating, A pixel pattern which arranges many grid lines in a predetermined pixel closed region, By changing an arrangement angle of a grid line, define more than one and a pixel pattern of these plurality, It divides into two or more groups by making into one group a pixel pattern which an arrangement angle of a grid line approximates mutually, One group is matched about each of two or more motifs which should be expressed, A multiplex pixel pattern obtained by arranging in piles a grid line arranged at each in the same pixel closed region about two pixel patterns which belong to a different group is defined, About a pixel which constitutes only a single motif. About a pixel which assigns a pixel pattern which belongs to a group matched with the motif to each sub-picture element

produced by dividing this, and constitutes two or more motifs. A pixel pattern which belongs to each of a group which was matched with each motif, or its multiplex pixel pattern is assigned to each sub-picture element produced by dividing this, A diffraction grating recording medium constituting so that a grid line arranged with a grid line arrangement angle relevant to each group may appear in at least one sub-picture element.

[Claim 9]A method of creating a diffraction grating recording medium which expressed a predetermined motif by a diffraction grating, comprising:

A stage which prepares the 1st pattern that arranges many 1st grid line that turned to the 1st direction as 1st topographic contour plot form data that expressed a border line of a space area between grid lines with a quadrangle.

A stage which prepares the 2nd pattern that arranges many 2nd grid line that turned to the 2nd direction as 2nd topographic contour plot form data that expressed a border line of a space area between grid lines with a quadrangle.

It asks for a multiplexed pattern on which the 1st pattern and 2nd pattern were put by a logical operation about the 1st topographic contour plot form data and the 2nd topographic contour plot form data, A stage prepared as 3rd topographic contour plot form data that expressed a crossing area of a quadrangle which constitutes the 1st topographic contour plot form data for this multiplexed pattern, and a quadrangle which constitutes the 2nd topographic contour plot form data with a new quadrangle.

A beam with a stage which forms a regist layer on an original edition composition layer, and character to change a state of said regist layer, A stage of performing beam irradiation only to a square type region which scanned based on the 3rd topographic contour plot form data in which said multiplexed pattern is shown, and was defined with this data, A stage of performing development which leaves only a beam irradiation field of said regist layers, A stage where an exposed region which is not covered with a residual regist layer among said original edition composition layers is etched with an etching method, and a square type region creates the original edition which makes convex, and a stage where a square type region creates a diffraction grating recording medium which makes a concave using said original edition.

[Claim 10]A method of creating a diffraction grating recording medium which expressed two or more motifs by a diffraction grating, comprising:

A stage which prepares two or more pixel patterns which arrange many grid lines in a predetermined pixel closed region by changing an arrangement angle of a grid line.

A stage which prepares motif pixel information which expressed a predetermined motif by defining two or more pixels which had a predetermined pixel value, respectively as a prescribed position on a flat surface about each of two or more motifs.

A stage which matches a predetermined pixel pattern with each picture element position based on each pixel value in said motif pixel information.

A stage of assigning this single pixel pattern about a picture element position where a single pixel pattern was matched, and assigning a multiplex pixel pattern on which these two matched pixel patterns were put about a picture element position where two different pixel patterns were matched.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a figure showing an example of the pattern used as a motif of the diffraction grating recording medium concerning this invention, and pixel information.
[Drawing 2]It is a figure showing an example of the pixel pattern used for the diffraction grating recording medium concerning this invention.
[Drawing 3]It is a figure showing the diffraction grating recording medium created using the pixel pattern shown in the motif shown in drawing 1, and drawing 2.
[Drawing 4]It is a figure showing an example of the pixel pattern used about two motifs shown in drawing 5, respectively.
[Drawing 5]It is a figure showing the example of two motifs recorded on the diffraction grating recording medium concerning this invention by overlapping.
[Drawing 6]It is a figure showing the correspondence relevant information which defines the correspondence relation between two motifs shown in drawing 5, and two pixel patterns shown in drawing 4.
[Drawing 7]It is a figure showing the state where the sub-picture element expressed two motifs shown in drawing 5, respectively.
[Drawing 8]It is a figure showing the diffraction grating recording medium created by arranging in piles two motifs shown in drawing 7.
[Drawing 9]It is a figure showing an example of the pixel pattern P1 used about two motifs shown in drawing 5, respectively, P2, and the multiplex pixel pattern P12 obtained by piling this up.
[Drawing 10]It is a figure showing the correspondence relevant information which defines the correspondence relation between two motifs shown in drawing 5, and three patterns shown in drawing 9.
[Drawing 11]It is a figure showing the diffraction grating recording medium created by assigning each pattern based on the correspondence relevant information shown in drawing 10.
[Drawing 12]The ratio of the linewidth dL and the space width dS is a figure showing two kinds of diffraction grating patterns which are 1:1.
[Drawing 13]It is a figure showing the multiplex diffraction grating pattern obtained by piling up two kinds of diffraction grating patterns shown in drawing 12.
[Drawing 14]The ratio of the linewidth dL and the space width dS is a figure showing two kinds of diffraction grating patterns which are 1:2.
[Drawing 15]It is a figure showing the multiplex diffraction grating pattern obtained by piling up two kinds of diffraction grating patterns shown in drawing 14.
[Drawing 16]It is a sectional side elevation showing the structure of a diffraction grating recording medium with the multiplex diffraction grating pattern shown in drawing 15.
[Drawing 17]It is a figure showing an example of the drawing method of the multiplex diffraction grating pattern shown in drawing 15.
[Drawing 18]It is a figure showing the negative pattern of the multiplex diffraction grating pattern shown in drawing 15.
[Drawing 19]It is a sectional side elevation showing the initial stage of the manufacturing process of the original edition used in order to mass-produce the diffraction grating recording medium concerning this invention.
[Drawing 20]In the state which shows in drawing 19, it is a sectional side elevation showing the state where it drew to the regist layer 3.
[Drawing 21]In the state which shows in drawing 20, it is a sectional side elevation showing the state where the

regist layer was developed.
[Drawing 22]In the state which shows in drawing 21, it is a sectional side elevation showing the state where etching to the original edition composition layer 2 was performed.
[Drawing 23]It is a sectional side elevation showing the state where carried out the strip of the residual resist and manufacture of the original edition was completed from the state shown in drawing 22.
[Drawing 24]It is a top view showing the technique for drawing the diffraction grating pattern concerning this invention, and a multiplex diffraction grating pattern with an electron beam.
[Drawing 25]It is a block diagram showing an example of the equipment configuration which creates the diffraction grating recording medium concerning this invention.
[Drawing 26]It is a figure for explaining the indicative data with a field used in the device shown in drawing 25.
[Drawing 27]It is a figure showing the layered structure of the data dealt with by the device shown in drawing 25.

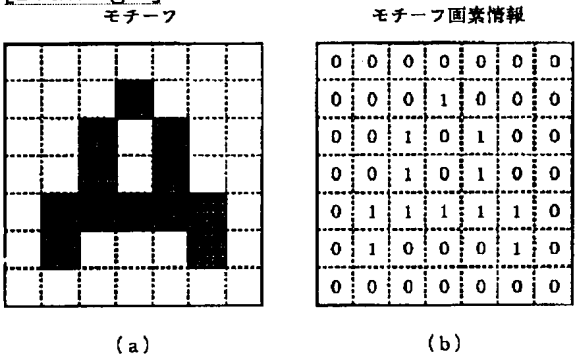
[Drawing 28]It is a figure showing the example using two or more pixel patterns about one motif.
[Drawing 29]It is a figure showing the pixel pattern used when recording three motifs in piles, and a multiplex pixel pattern.
[Drawing 30]It is a figure showing three motifs expressed using the pixel pattern shown in drawing 29, and a multiplex pixel pattern, and the correspondence relation of a pixel.
[Drawing 31]It is a figure showing the example which records three motifs in piles using a sub-picture element.
[Drawing 32]It is a figure showing the example which records four motifs in piles using a sub-picture element.
[Description of Notations]
1 -- Substrate
2 -- Original edition composition layer
3 -- Regist layer
3a -- Exposure part
3b -- Non-exposed area
10 -- Motif image data input device
20 -- Workstation
30 -- Memory storage
40 -- Data-format-conversion device
50 -- Electron beam exposure system
60 -- Diffraction grating record original edition
70 -- Press device
80 -- Multiplex diffraction grating recording medium
85 -- Hollow
86 -- Shield wall
A, B, C -- Motif
CC -- Crossing area
D1, D2 -- Observation direction
L -- Line of a grid line
P1-P6 -- Pixel pattern
P12, P13, P23, P123 -- Multiplex pixel pattern
R1, R2 -- Correspondence relevant information
S -- Space of a grid line
SS -- Square space
T -- Space excepted from the drawing object
TT -- Space excepted from the drawing object
U -- Dragonfly mark (position information)
V -- Closed region which arranges a grid line
X, Y -- Axis of coordinates
dL -- Linewidth of a grid line
dS -- Space width of a grid line
p -- Pitch of a grid line
theta -- Arrangement angle of a grid line

[Translation done.]

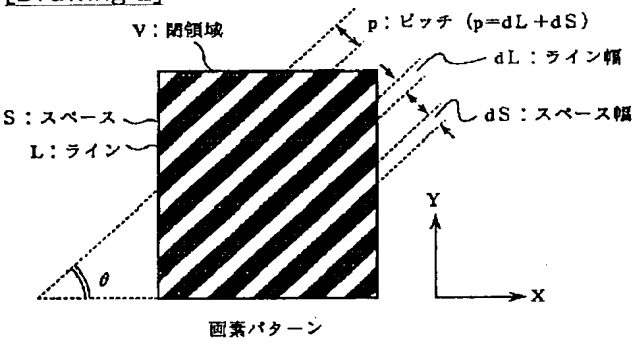
* NOTICES *

DRAWINGS

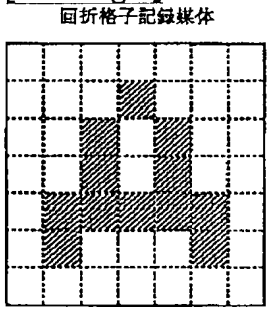
[Drawing 1]



[Drawing 2]

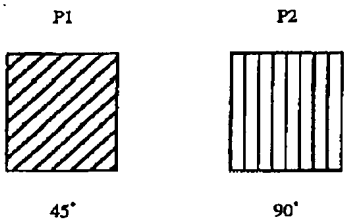


[Drawing 3]

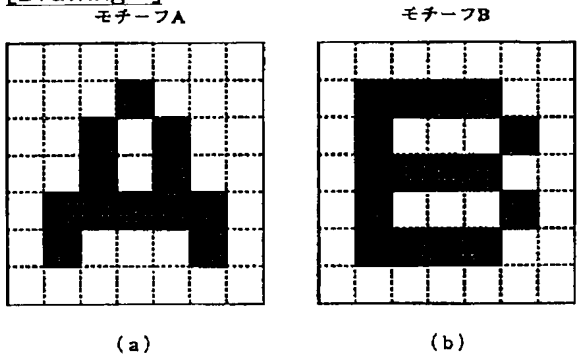


[Drawing 4]

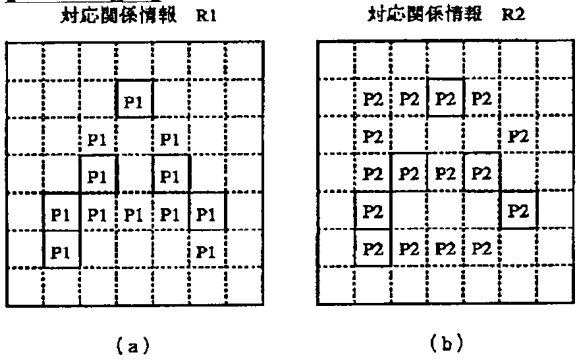
画素パターン



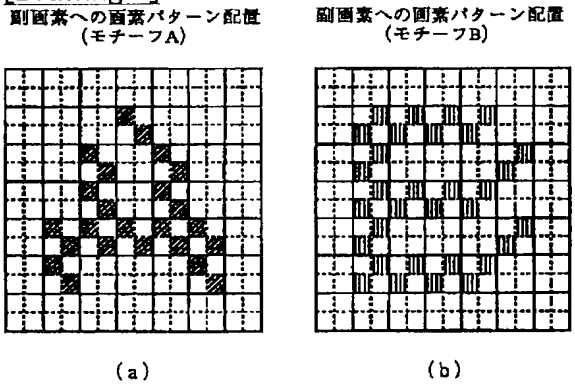
[Drawing 5]



[Drawing 6]

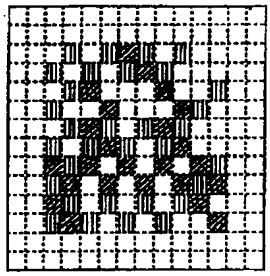


[Drawing 7]



[Drawing 8]

回折格子記録媒体



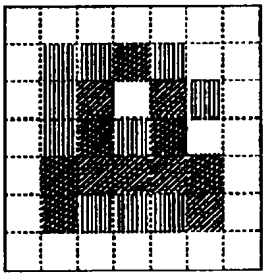
[Drawing 10]

対応関係情報

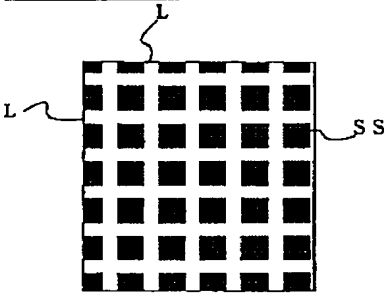
	P2	P2	P12	P2	
	P2	P1		P1	P2
	P2	P12	P2	P12	
	P12	P1	P1	P1	P12
	P12	P2	P2	P2	P1

[Drawing 11]

回折格子記録媒体

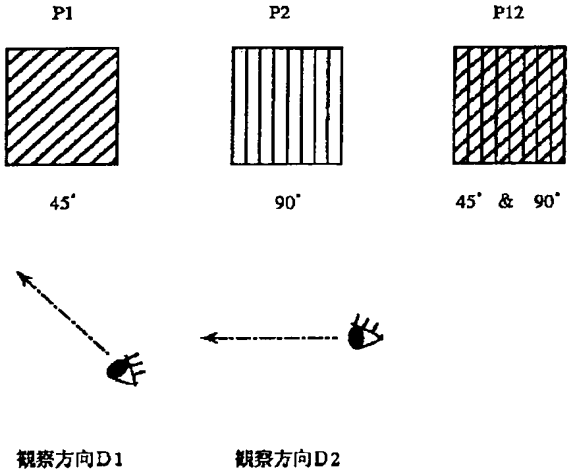


[Drawing 18]



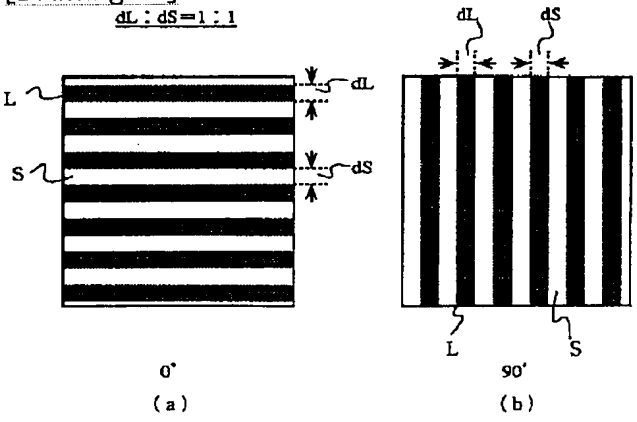
[Drawing 9]

画素パターン



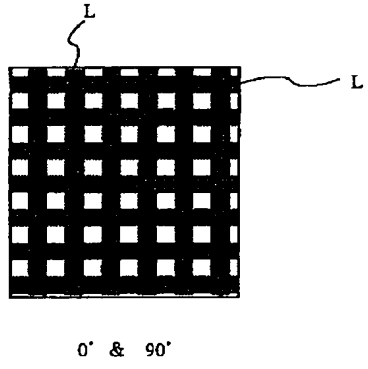
[Drawing 12]

dL：dS=1：1

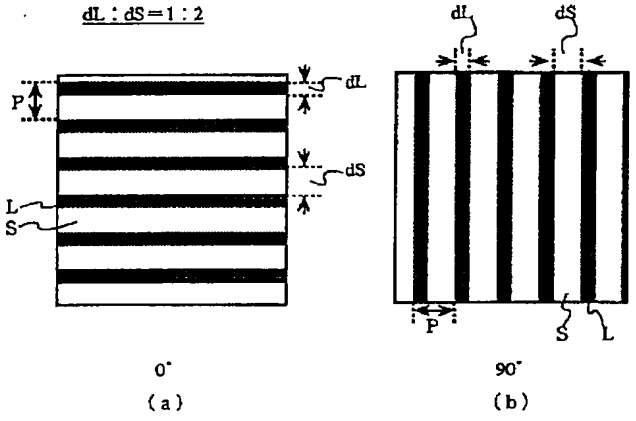


[Drawing 13]

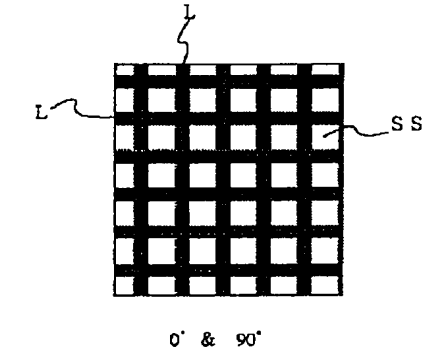
dL：dS=1：1



[Drawing 14]



[Drawing 15]



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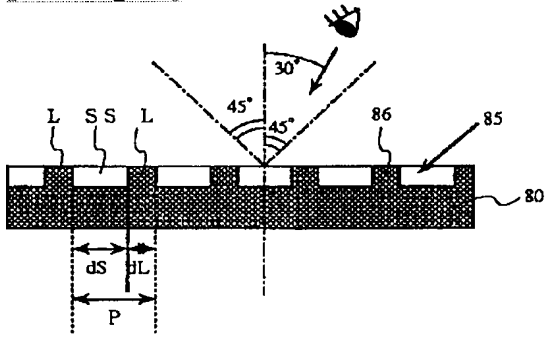

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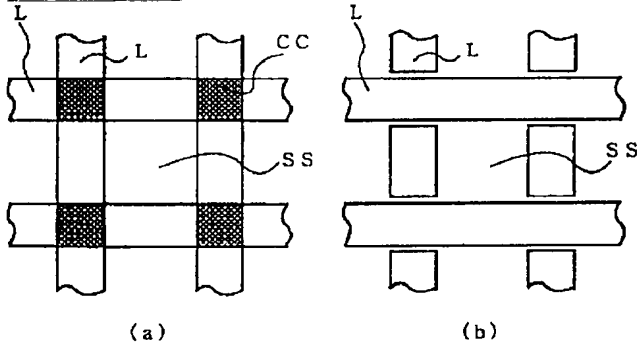
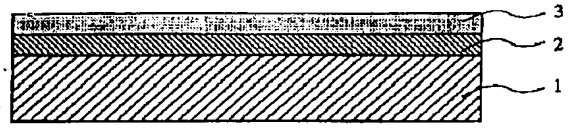
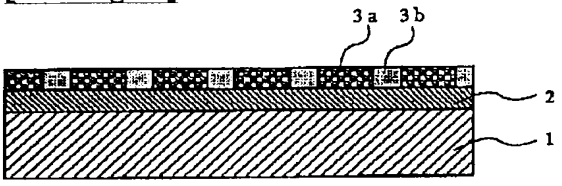


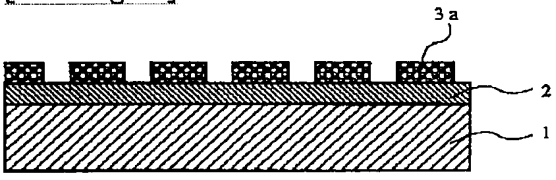
[Drawing 19]



[Drawing 20]



[Drawing 21]



[Drawing 22]

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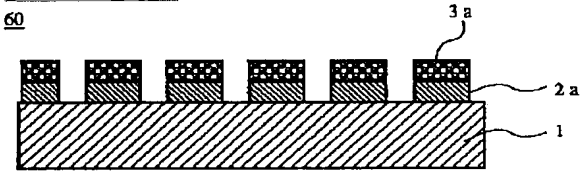

[Drawing 23]

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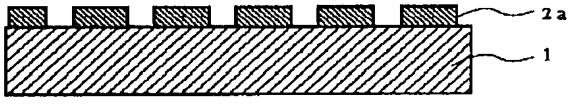
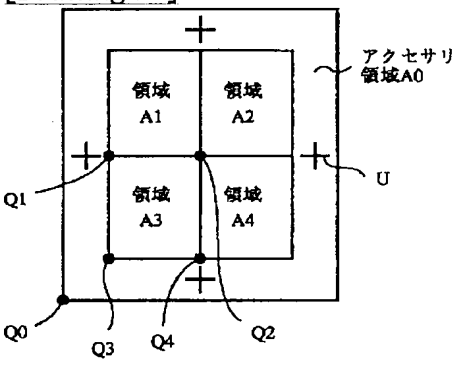


[Drawing 26]



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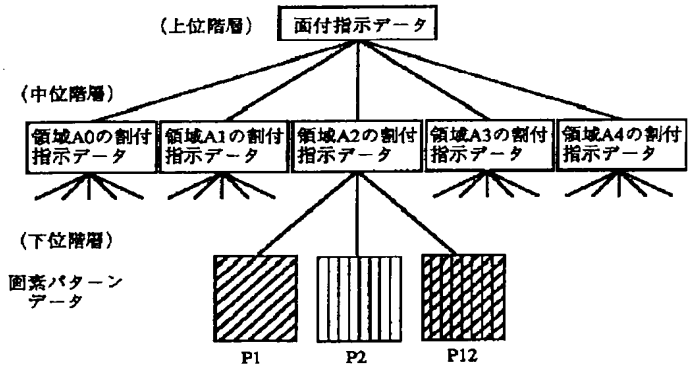

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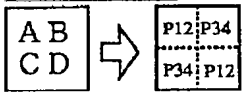

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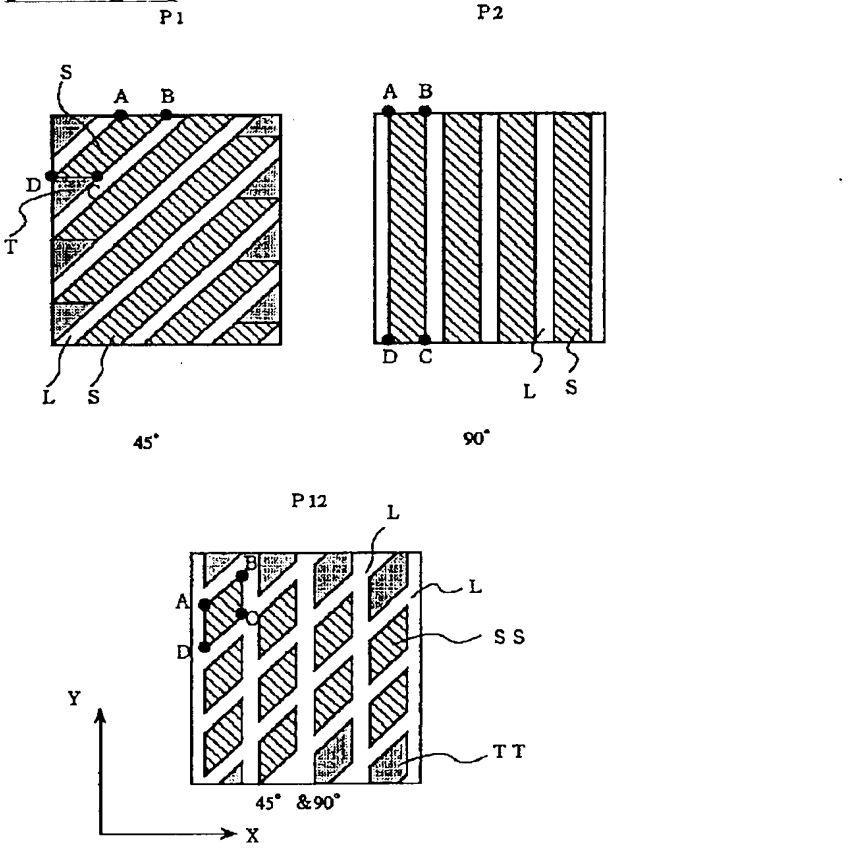
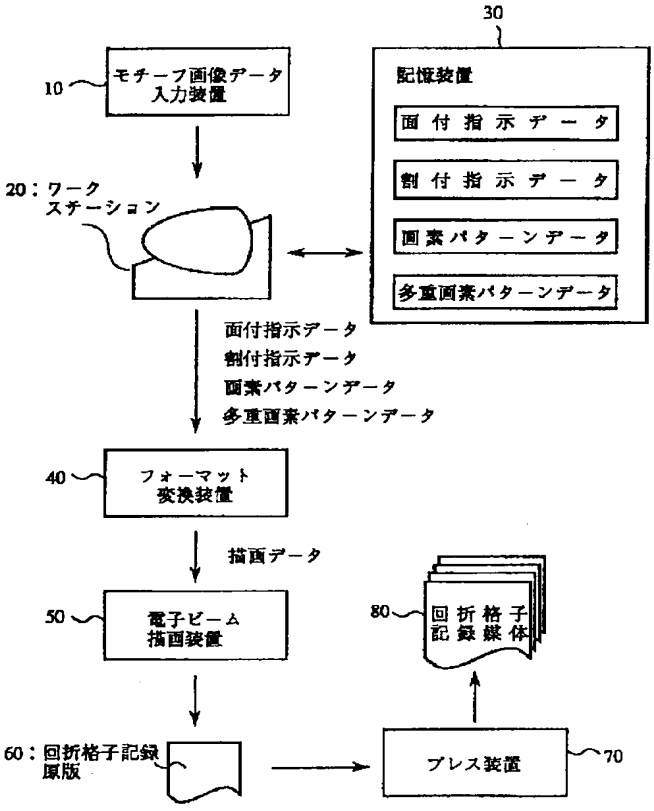
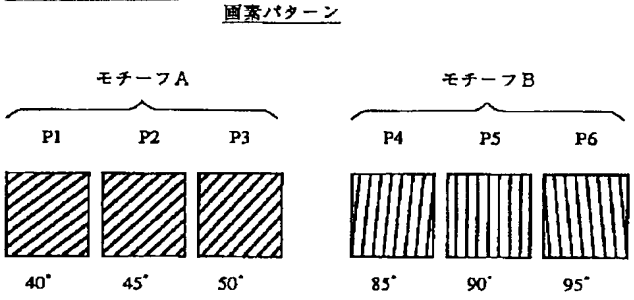


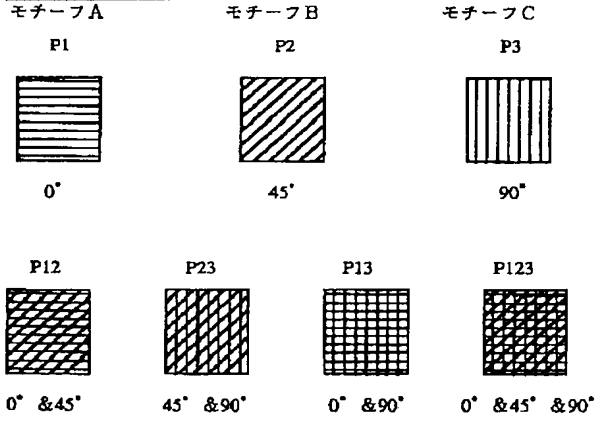
[Drawing 25]



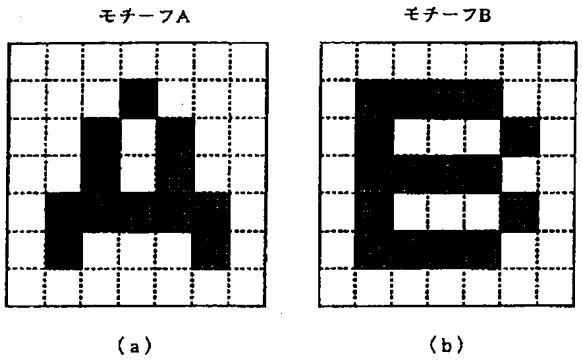
[Drawing 28]

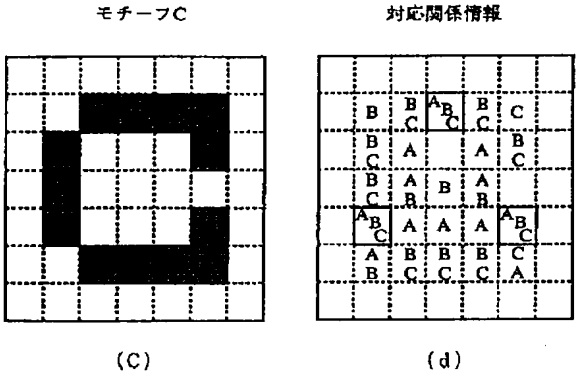


[Drawing 29]

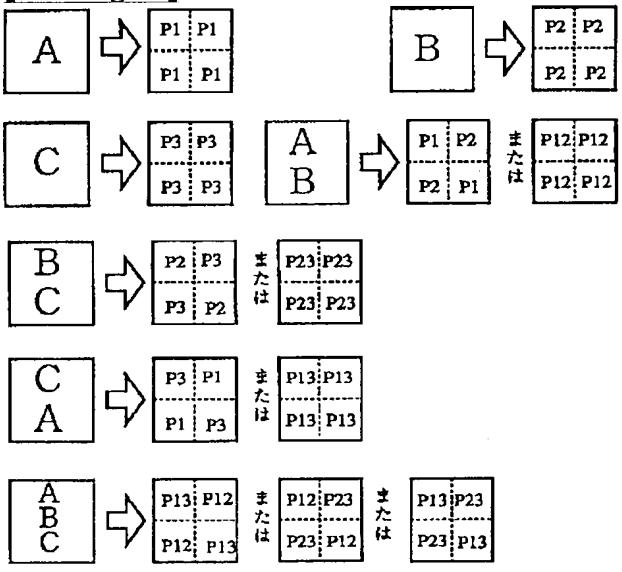


[Drawing 30]





[Drawing 31]



[Translation done.]